DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
DEFENSE SCIENCES OFFICE (DSO)
PLANNED PROCUREMENTS
December 2001

PROGRAM DESCRIPTION	FUNDING	SCHEDULE	PROGRAM MGR
Defense Sciences Research and Technology: This program seeks to explore promising high-risk/high-payoff technologies within a broad spectrum of the science and engineering research communities and to develop those technologies into important, radically new military capabilities. There are four technical areas that are of primary interest: (1) new materials, materials concepts, materials processing and devices; (2) application of advanced mathematics to problems of interest to the Department of Defense; (3) technologies to render harmless biological and chemical warfare attacks against the US military; and (4) applications of biology to Defense applications. The proposed research must lead to revolutionary changes in technology that have the potential to make significant improvements in national security and/or military operations.	TBD	BAA 01-42 Proposals due: 8/29/02	Dr. Steven Wax DSO
Brain Machine Interfaces (BMI): This program will explore the creation of new technologies for augmenting human performance through the ability to non-invasively access codes in the brain in real time and integrate them into peripheral device or system operations. The following six areas will be addressed: (1) extraction of neural and force dynamic codes related to patterns of motor or sensory activity required for executing simple to complex motor or sensory activity; (2) determination of necessary force and sensory feedback (positional, postural, visual, acoustic, other) from a peripheral device or interface that will provide critical inputs required for closed loop control of a working device; (3) new methods, processes, and instrumentation for accessing neural codes non-invasively at appropriate spatiotemporal resolution to provide closed loop control of a peripheral device; (4) new materials and device design and fabrication that embody compliance and elastic principles and capture force dynamics that integrate with neural control commands; (5) demonstrations of plasticity from the neural system and from an integrated working device or system that result in real-time control under relevant conditions of force perturbation and cluttered sensory environments from which tasks must be performed; and (6) biomimetic implementation of controllers (with robotics or other devices and systems) that integrate neural sensory or motor control integrated with force dynamic and sensory feedback from a working device or system.	TBD	BAA 01-42, Addendum 1 Proposals due: 8/29/02 Total program: 5 years	Dr. Alan Rudolph DSO

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Biological Input/Output Systems (BIOS): This initiative will develop robust technologies for designing DNA-encoded "plug and play" modules that will enable the use of organisms (e.g., plants, microbes, lower eukaryotes) as remote sentinels for reporting the presence of chemical or biological analytes. The ability to design and use organisms as sentinels is limited by the ease with which their molecular components and pathways can be designed and assembled to generate new sensing and reporting capabilities. The BIOS program, therefore, seeks to develop revolutionary technologies that will lead to facile engineering and assembly of functional biological circuits and pathways in living organisms. The interdisciplinary efforts will be drawing on expertise from such areas as structural biology, protein design, genetics, gene regulation, olfaction, membrane biology, chemical engineering, analog circuit design, applied math, network analysis, metabolism, signal transduction, plant biology, toxicology and pathogenesis.	TBD	BAA 01-42, Addendum 2 Proposals due: 8/29/02 Total program: 3 years	Dr. Eric Eisenstadt DSO
BioMagnetic Interfacing Concepts (BioMagnetICs): This program will develop core technologies that will enable nanoscale magnetics to be integrated into biology and demonstrated as a novel transduction mechanism for the detection, manipulation, and functional control of single bio-molecules and cells. A bio-magnetic transduction mechanism offers solutions to outstanding technical issues that keep many exciting advances in biotechnology from being taken out of the laboratory and fielded for DoD use. Some of these technical issues include the need for increased sensitivity, requirements for minimal sample preparation, robust detection in chemically noisy environments, and portability. The core technologies that will be developed under this program include: (1) novel, bio-compatible ferrofluids, or magnetic tags, with superior magnetic properties that are capable of attaching to single biomolecules and cells with a high degree of specificity; (2) bio-compatible, high sensitivity magnetic sensors capable of detecting single magnetic nanoparticles with 100 nm or less diameters; and (3) high density magnetic tweezers that are bio-compatible and capable of manipulating single magnetic nanoparticles, attached to bio-molecules, with nano-scale precision. It is anticipated that investments in these core areas will lead to revolutionary new capabilities on par with the discovery of optical microscopy in terms of their potential to advance our understanding and exploitation of biology at the cellular and sub-cellular levels.	TBD	BAA 01-42, Addendum 3 Proposals due: 8/29/02 Total program: TBD	Dr. Valerie M. Browning DSO

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Bio Optic Synthetic Systems (BOSS): The goal of this program is to demonstrate a bio-inspired lens having a dynamically controllable field of view (ranging from less than 1 degree to greater than 120 degrees). This will be achieved by developing materials exhibiting a variable index of refraction. A dynamically variable lens compound that exhibits a full point (1.0) reversible change in the index of refraction in the visible is planned as a phase 1 demonstration. In addition, fabrication techniques for engineering hierarchical structures that provide these unique optical properties will be explored. Self-assembly processes to fabricate materials with a variable reflection in the visual to near-IR that acts as a wavelength variable bandpass filter will be demonstrated. The inspiration for these new designs will be based on biological systems that demonstrate impressive performance at reduced size and complexity (when compared to conventional man-made systems). This program will develop novel synthesis routes to fabricate materials having extreme optical, sensing, and electro-optical properties.	TBD	BAA 01-42 Addendum 4 Proposals due: 8/29/02 Total program: 4 years	Dr. Leonard J. Buckley DSO
Water Harvesting: The distribution of water places immense logistical stress on the rapidly deployed, self-sustaining military operation. The goal of this program is to reduce the logistics burden of distributing such immense amounts of water by 50%. To accomplish this goal, this program will develop revolutionary ways to: (1) harvest water for the individual soldier (or small groups of them) from on-the-spot sources where none appear available, in a conventional sense (e.g., water from air, wet soil or mud, combusted hydrocarbons, warfighter's excretions, etc.), and (2) purify water from conventional, sweet/salty and often contaminated sources for 1 to 10,000 soldiers, with exceptionally low energy requirements and ideally engineered and sized packaging. This program will aggressively pursue technologies and applications that will enable the Services to avoid transporting water into a theater of operation.	TBD	BAA 01-42 Addendum 5 Proposals due: 01/15/02 Open through: 8/29/02 Total program: 5 years	Dr. Mike Gardos DSO
Persistence in Combat (PIC): This program seeks innovative research and development of technologies that will enable the warfighter to administer self-aid without relying on outside support. The vision of this program is to maintain Persistence in Combat by allowing a warfighter to overcome those minor to moderate injuries that make up a majority of casualties in the battlefield, thereby significantly reducing the requirements for medic support and/or evacuation. The specific objectives are to reduce evacuation by a factor of 10 through stabilizing the injury and relieving the pain in 5 minutes or less. In order to accomplish this goal, researchers will need to exploit the human body's innate capabilities to accelerate the healing process in the following areas: (1) acute incapacitating minor tissue injury; (2) acute non-compressible hemorrhage; and (3) acute intractable pain.	TBD	BAA 01-42 Addendum 6 Proposals due: 2/4/02 Total program: 5 years	Dr. Kurt Henry DSO

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Morphing Aircraft Structures: The overall goal of this program is to create and advance enabling technologies and ultimately design, build, and demonstrate a seamless, aero-efficient, radically shape changing aerial vehicle. The ability to change critical physical characteristics, while in flight, would grant the operator the authority to govern the performance of a single vehicle to fit many mission profiles while in flight. The ability to morph would heavily influence performance characteristics such as turning radius, endurance, payload, and maximum velocity. These new technology development efforts should provide proof of principle demonstrations of a flight traceable morphing wing within 30 months of the projects undertaking. Critical geometry changes necessary for tailoring or enhancing vehicle performance will be identified early in the effort, and the controls, actuation and structure development shall be focused towards achieving these morphing capabilities. Examples of specific controlled geometry changes include, but are not limited to, the following: 200% change in aspect ratio, a change in wing area by 50%, 5^{o} change in wing angle of attack, and ability to alter the wing sweep by 20^{o}. The effort will culminate in the wind tunnel testing of a flight traceable wing in the sub-sonic regime.	TBD	BAA 01-42 Addendum 7 Proposals due: 8/29/02 Total program: 3 years	Dr. Ephrahim Garcia DSO
Synthetic MultiFunctional Materials (SMFM): The SMFM program seeks to advance materials capabilities by integration of structural/mechanical attributes through the establishment of basic understanding and principles, synthesis/processing routes, rules and tools for the design of and design with multifunctional materials. It aims to offer options for achieving reduced weight, higher levels of performance, more flexibility in design, reduction of complexity and greater reliability in military systems. Material systems that integrate structural/mechanical performance with one or more other functions (e.g., power generation, self-repair/self-monitoring, sensing, actuation, thermal management, ballistic and/or blast protection, signature management, catalytic/surface chemical activity, etc.) are of interest. Research that draws upon (but is not limited to) bio-inspiration as a source of models for multifunctional engineering materials; inherently intelligent materials, i.e., those that respond locally to imposed environments without assistance, and that can sustain self-sensing, self-actuation, local information processing, self-repair with a minimum of externally supplied power; precision tailoring of materials systems through control of microstructure, surfaces, interfaces, grain boundaries and other material attributes in terms of composition, defect state, crystallography, morphology etc., is strongly encouraged.	TBD	Addendum to BAA 01-42 1QFY02 Total program: 4 years	Dr. Leo Christodoulou

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Prognosis: The major limitation in the readiness of combat systems/platforms is the lengthy inspections with the resultant conservative "go, no-go" operation decisions made to avoid the failure of materials in critical components. The goal of this program is to manage this "fear of failure" through the determination of remaining usable life and the quantitative prediction (Prognosis) of future operating capability. As a result, commanders will have the ability to adaptively manage, deploy and use combat systems/platforms that otherwise would have been removed from service. This program will develop novel methods for interrogating materials (local and global) that respond to the intrinsic behavior of the materials and link this signature to physics-based multi-scale models that capture the failure and damage accumulation in materials and their cascading effect on future performance. The problem of prediction is made tractable by applying physics-based approaches to the nucleation and growth of failure-causing defects; by tracking the evolution in the microstructure through models and suitable interrogation tools; and by constraining the predictions to the short term (imminent missions, 10-100 hours). The objective of Phase I is to demonstrate the feasibility of using the Prognosis concept to provide timely and useful information about the state and future performance of a specific component in a complex mechanical subsystem such as the turbine engine. Phase II will focus on technology development.	TBD	Addendum to BAA 01-42 1QFY02 BAA 3QFY02 Total program: 5 years	Dr. Leo Christodoulou DSO